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ANALYZING THE PROFITABILITY AND LOAN REPAYMENT ABILITY OF IRRIGATION SYSTEMS WITH RESPECT TO CROPS ON THE SANDY SOILS IN WEST CENTRAL MINNESOTA

by

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A farmer contemplating the purchase of an irrigation system should make two cost and return analyses. First, the long term profitability of the investment should be evaluated. Second, the effect of the investment on the short-term cash flow of the farming business should also be estimated.

An Example Situation: John Farmer is considering investing in a self-propelled center pivot irrigation system to use in producing a quarter section of corn. The following information is given.

		Your Farm
Estimated Well Depth	70 feet	_____
Estimated Lift	20 feet	_____
Engine Size Needed	114 H.P. internal combustion or 90 H.P. electric motor	_____
Tillable Acres in Quarter	150	_____
Acres Irrigated	130	_____
Inches of Water Applied/Acre	12	_____
Acre Inches of Water Pumped/Yr.	1,560	_____
Hours of Operation Per Year = $\frac{450}{GPM}$ x Ac. in. per year	780	_____
Interest Rate	9%	_____
GPM	900	_____

I. The Long-Run Profitability

A. Estimate Investment and Annual Fixed Costs

System Component	Example: Initial Investment Cost	Example: Years Useful Life	Example: Depreciation Per Year	Your Farm: Initial Cost	Your Farm: Depreciation Per Year
Well, Casing, Screen and Gravel Pack	$ 3,756	25	$ 150.24	_____	_____
Centrifugal Pump	1,377	15	91.80	_____	_____
115 H.P. Diesel Engine	5,200	12	433.33	_____	_____
Fuel Tank	650	12	38.24	_____	_____
Engine and Pump Base	300	25	12.00	_____	_____
1,000 Ft. Mainline	2,000	20	100.00	_____	_____
C.P. Sprinkler	28,000	15	1,866.67	_____	_____
1. Total Initial Investment	$41,283			_____	
2. Annual Depreciation			$2,692.28		_____
3. Interest on the Average Investment			1,857.74		_____
$\frac{\text{Total Initial Investment}}{2}$ x Interest Rate					
4. Insurance			187.00		_____
Avg. Investment (Excluding Well) x .01					
5. Total Annual Fixed Cost			4,737.02		_____

B. Estimate Annual Variable Costs of Irrigation System

		Example	Your Farm
1.	Fuel 5.314 gal./hr. x 780 hrs. x $.38	$1,574.77	
2.	Lubrication	122.01	
3.	Repairs Engine	428.94	
	Pump	70.06	
	Sprinkler System	450.00	
4.	Labor 130 A. Irr. x 10 Irr. Annually x .1 Hr. x $3.00/Hr.	390.00	
5.	Total Variable Costs of Irrigation System	$3,035.78	

II. The Cash Flow

The effect of the investment on the annual cash flow of the business can be estimated by repeating the calculations for each year using cash flow costs rather than annual costs. The effect of the investment on the income taxes paid (through investment credit, depreciation and interest paid on borrowed funds) is also an important consideration.

Only the effect on net cash costs is considered in the analysis that follows. Then the additional returns required per acre to cover these costs is computed for each year.

The following information was used in making the estimates for a 12 year period.

The amount borrowed is $41,282.
The financing method is a ten year amortized loan.
The interest rate is 9%.
The investment is depreciated for tax purposes at the double declining balance rate.
The tax bracket is 30%.
Annual cash costs are:

Insurance	$ 187.00
Added Variable Costs	3,036.00
	$3,223.00

Projected Changes in Net Cash Costs After Taxes and Loan Payments for the First 12 Years of the Investment

Year	Net Cash Cost before Taxes and Payments	Change in Taxes*	Loan Payments	Net Cash Cost after Taxes and Payments	Increased Returns Required to Pay After Tax Cash Cost Increase**	
					Total	Per Acre
1	$3,223	$-7,861	$6,433	$1,794	$ 2,565	$19.73
2	3,223	-3,439	6,433	6,216	8,889	68.38
3	3,223	-3,168	6,433	6,487	9,276	71.35
4	3,223	-2,916	6,433	6,740	9,638	74.14
5	3,223	-2,678	6,433	6,978	9,979	76.76
6	3,223	-2,450	6,433	7,206	10,305	79.27
7	3,223	-2,229	6,433	7,426	10,619	81.69
8	3,223	-2,013	6,433	7,643	10,929	84.07
9	3,223	-1,798	6,433	7,858	11,237	86.44
10	3,223	-1,582	6,433	8,074	11,546	88.82
11	3,223	-1,362	0	1,861	2,661	20.47
12	3,223	-1,309	0	1,914	2,737	21.05

* Investment credit available and tax rate (depreciation + interest payments + net cash costs)

** A return of $1.43 is needed to provide $1.00 after tax income for the 30% tax bracket used in this example. The increased returns are computed for the 130 acres actually irrigated.

If an individual is unable to obtain yield increases as great as those computed using this procedure it means some other segment of the business will need to subsidize the irrigation farming until the loan is repaid. (Perhaps at that time it can help to subsidize some other investment.)

Corn Budget
Grain Per Acre

	Dryland			Irrigated (12 inches)		
	Quantity	Price	Amount	Quantity	Price	Amount
Returns						
Corn	45 bu.	2.50	$112.50	120 bu.	2.50	$300.00
Total Returns			$112.50			$300.00
Planting Costs						
Plow 5-16"	.34 hr.	14.89	5.06			5.06
Disk - 16' (twice)	.12 hr.	14.30	3.43			3.43
Harrow 48'	.03 hr.	16.99	.51			.51
Corn Planter 6-36"	.15 hr.	16.11	2.42			2.42
Corn Seed			8.50			13.00
Nitrogen	40 lb.	.23	9.20	150 lb.	.23	34.50
Phosphate	20 lb.	.20	4.00	50 lb.	.20	10.00
Potash	40 lb.	.08	3.20	100 lb.	.08	8.00
Spraying 30'	.07 hr.	9.37	.66	.07 hr.	9.37	.66
Herbicides			10.00			18.00
Insecticides						4.00
Maintenance Costs						
Cultivation 6-36	.14 hr.	10.66	1.49			1.49
Irrigation						59.80
Harvest Costs						
Combine 3-36	.35 hr.	27.36	9.58	.45 hr.	27.36	12.31
Hauling	.21 hr.	6.50	1.36	.40 hr.	6.50	2.60
Drying	22.5 bu.	.18	4.05	60.0 bu.	.18	10.80
Shred Stalks - 12'	.23 hr.	12.04	2.77			2.77
Other Costs						
Interest on Operating Capital	49.17	.09	4.42	129.97	.09	11.70
Interest on Land	400.00	.07	28.00	400.00	.07	28.00
Taxes on Land	400.00	.01	4.00	400.00	.01	4.00
Crop Insurance	112.50	.025	2.81	300.00	.025	7.50
Total Costs Listed			$105.46			$240.55
Return Above Costs Shown			$7.04			$59.45

Soybean Budget
Per Acre

	Dryland			Irrigated (6 inches)		
	Quantity	Price	Amount	Quantity	Price	Amount
Returns						
Soybeans	15 bu.	5.00	$ 75.00	40 bu.	5.00	$200.00
Total Returns			$75.00			$200.00
Planting Costs						
Disk - 16' (twice)	.12 hr.	14.30	3.44			3.44
Harrow 48'	.03 hr.	16.99	.51			.51
Planter 6-36	.15 hr.	16.11	2.42			2.42
Soybean Seed			6.00			10.00
Phosphate	0			50 lb.	.20	10.00
Potash	0			100 lb.	.08	8.00
Spraying 30'				.07 hr.	9.37	.66
Herbicides						15.00
Maintenance Costs						
Cultivation 6-36	.14 hr.	10.66	1.49			1.49
Irrigation						48.18
Harvest Costs						
Combine 16 ft.	.15 hr.	19.19	2.88	.20 hr.	19.19	3.81
Hauling	.12 hr.	6.50	.78	.17 hr.	6.50	1.11
Other Costs						
Interest on Operating Capital	10.74	.09	.97	60.05	.09	5.41
Interest on Land	400.00	.07	28.00	400.00	.07	28.00
Taxes on Land	400.00	.01	4.00	400.00	.01	4.00
Crop Insurance	75.00	.025	1.88	200.00	.025	5.00
Total Costs Listed			$52.37			$147.03
Returns Above Costs Shown			$22.63			$52.97

Wheat Budget
Per Acre

	Dryland			Irrigated (6 inches)		
	Quantity	Price	Amount	Quantity	Price	Amount
Returns						
Wheat	25 bu.	3.50	$ 87.50	50 bu.	3.50	$175.00
Total Returns			$87.50			$175.00
Planting Costs						
Disk - 16' (twice)	.12 hr.	14.30	3.44			3.44
Harrow 48'	.03 hr.	16.99	.51			.51
Grain Drill - 16'	.14 hr.	17.82	2.49			2.49
Seed			5.00			8.00
Nitrogen	20 lb.	.23	4.60	60 lb.	.23	13.80
Phosphate	20 lb.	.20	4.00	40 lb.	.20	8.00
Potash	20 lb.	.08	1.60	40 lb.	.08	3.20
Maintenance Costs						
Irrigation						48.18
Harvest Costs						
Combine 16 ft.	.15 hr.	19.19	2.88	.20 hr.	19.19	3.84
Hauling	.12 hr.	6.50	.78	.17 hr.	6.50	1.11
Other Costs						
Interest on Operating Capital	19.34	.09	1.74	49.40	.09	4.45
Interest on Land	400.00	.07	28.00	400.00	.07	28.00
Taxes on Land	400.00	.01	4.00	400.00	.01	4.00
Crop Insurance	87.50	.025	2.19	175.00	.025	4.38
Total Costs Listed			$61.29			$133.40
Returns Above Costs Shown			$26.21			$41.60

Alfalfa Hay
Preceded by Year of Establishment
Per Acre

	Dryland (2 cuttings)			Irrigated (12 in.) (3 cuttings)		
	Quantity	Price	Amount	Quantity	Price	Amount
Returns						
Alfalfa Hay	2.5 ton	60.00	$150.00	5.0 ton	60.00	$300.00
Total Returns			$150.00			$300.00
Planting Costs						
Phosphorus	40 lbs.	.20	8.00	80 lbs.	.20	16.00
Potash	60 lbs.	.08	4.80	120 lbs.	.08	9.60
Maintenance Costs						
Irrigation						59.80
Harvest Costs						
Swather Conditioner	.18 hr.	18.92	6.94	.18 hr.	18.92	10.41
Rake	.29 hr.	9.86	2.82	.29 hr.	9.86	2.82
Baler Square	.30 hr.	10.95	6.62	.35 hr.	10.95	11.50
Twine ($2.40/ton)			6.00			12.00
Hauling	.30 hr.	6.50	3.90	.35 hr.	6.50	6.83
Other Costs						
Interest on Operating Capital	28.60	.09	2.57	74.76	.09	6.73
Interest on Land	400.00	.07	28.00	400.00	.07	28.00
Taxes on Land	400.00	.01	4.00	400.00	.01	4.00
Crop Insurance	150.00	.025	3.75	300.00	.025	7.50
Total Costs Listed			$77.40			$175.19
Returns Above Costs Shown			$72.60			$124.81

Sugar Beet Budget
Irrigated Only (22 inch rows)

	Quantity	Price	Amount
Returns			
Sugar Beets	18 ton	$30.00	$540.00
Total Returns			$540.00
Planting Costs			
Plow 5-16	.34 hr.	14.89	5.06
Disk 16' (twice)	.12 hr.	14.30	3.44
Harrow 48'	.03 hr.	16.99	.51
Sugar Beet Seed	2 lb.	5.50	11.00
Beet Planter 12 Row	.21 hr.	37.90	7.96
Nitrogen	150 lb.	.23	34.50
Phosphorus	40 lb.	.20	8.00
Potash	100 lb.	.08	8.00
Sprayer 30'	.07 hr.	9.37	.66
Herbicides			18.00
Insecticides			8.00
Maintenance Costs			
Beet Thinner 6 Row	.48 hr.	32.92	15.80
Beet Cultivator 12 Row (3 times)	.17 hr.	26.46	13.49
Weeding Labor			24.00
Harvest Costs			
Beet Topper 4 Row	.23 hr.	23.99	5.52
Beet Lifter 4 Row	.29 hr.	46.96	13.62
Hauling Trucks	15 ton	2.00	30.00
Other Costs			
Interest on Operating Capital	155.71	.09	14.01
Interest on Land	400.00	.07	28.00
Taxes on Land	400.00	.01	4.00
Crop Insurance	540.00	.025	13.50
Total Costs Listed			$267.07
Return Above Costs Shown			$272.93

Increased Yields Required to Cover the After Tax Net Cash Costs by Year*

Year	Increased Returns Required For Irrigation Equipment**	Crop			
		Corn ($2.50 bu.)	Soybeans ($5.00 bu.)	Wheat ($3.50 bu.)	Alfalfa ($60.00 ton)
1	$19.73	47.4	15.6	15.8	1.35
2	68.38	66.8	25.3	29.7	2.16
3	71.35	68.0	25.9	30.6	2.21
4	74.14	69.1	26.5	31.4	2.26
5	77.76	70.6	27.2	32.4	2.32
6	79.27	71.2	27.5	32.8	2.34
7	81.69	72.1	28.0	33.5	2.38
8	84.07	73.1	28.5	34.2	2.42
9	86.44	74.0	28.9	34.9	2.46
10	88.82	75.0	29.4	35.6	2.50
11	20.47	47.6	15.7	16.0	1.36
12	21.05	47.9	15.9	16.2	1.37

* Increased yields at given prices must pay for irrigation costs plus additional associated costs of growing the specific crops under irrigated conditions.

** Indicates net cash flows before taxes to cover fixed payments of irrigation equipment.

Table 1: A Comparison of Costs of Alternative Systems Irrigating a Quarter Section Pumping From a Surficial Aquifer

Water Situation	900 Gallons Per Minute and <20' Lift				600 Gallons Per Minute and <20' Lift			
Type Fuel	Diesel		Electricity		Diesel		Electricity	
Type System	Center Pivot	Tow Line	Center Pivot	Tow Line	Center Pivot	Tow Line	Center Pivot	Tow Line
Initial Investment								
Well Development	$ 3,756	$ 3,756	$ 3,756	$ 3,756	$ 3,756	$ 3,756	$ 3,756	$ 3,756
Pump, Base and Drive	1,377	1,377	1,377	1,377	991	991	991	991
Engine and Fuel Tank on Motor and Controls	6,150	6,150	4,350	4,350	6,150	6,150	1,767	1,767
Distribution System	30,000	13,800	30,000	13,800	30,000	11,100	30,000	11,100
Total	$41,283	$25,083	$39,483	$23,283	$40,897	$21,997	$36,514	$17,614
Annual Fixed Costs								
Depreciation	2,692	1,953	2,375	1,636	2,666	1,659	2,246	1,239
Interest @ 9%	1,858	1,129	1,777	1,048	1,840	990	1,643	793
Insurance	187	107	178	98	186	91	164	69
Total	$ 4,737	$ 3,189	$ 4,330	$ 2,782	$ 4,692	$ 2,740	$ 4,053	$ 2,101
Variable Costs to Apply 12" of Water								
Fuel*	1,575	1,817	1,159	1,337	1,586	1,831	1,166	1,346
Lube	122	138	19	22	154	177	26	30
Repairs	949	909	549	443	1,140	1,160	587	442
Labor @ $3.00	390	1,080	390	1,080	390	1,080	390	1,080
Total	$ 3,036	$ 3,944	$ 2,117	$ 2,882	$ 3,270	$ 4,248	$ 2,169	$ 2,898
Annual Costs Per Acre Irrigated								
Acres Irrigated	130	150	130	150	130	150	130	150
Fixed Costs	36.44	21.26	33.31	18.55	36.09	18.27	31.17	14.01
Variable Costs	23.35	26.29	16.28	19.21	25.15	28.32	16.68	19.32
Total	$ 59.79	$ 47.55	$ 49.59	$ 37.76	$ 61.24	$ 46.59	$ 47.85	$ 33.33

* Fuel prices used are $.38 per gallon of diesel and $.024 per KWH.

Table 2: A Comparison of Costs for Alternative Systems Irrigating a Quarter Section From a Well With 100 Feet of Lift

Water Situation	900 Gallons Per Minute and 100' Lift				600 Gallons Per Minute and 100' Lift			
Type Fuel	Diesel		Electricity		Diesel		Electricity	
Type System	Center Pivot	Tow Line	Center Pivot	Tow Line	Center Pivot	Tow Line	Center Pivot	Tow Line
Initial Investment								
Well Development	$ 8,560	$ 8,560	$ 8,560	$ 8,560	$ 8,560	$ 8,560	$ 8,560	$ 8,560
Pump, Base and Drive	7,272	7,272	5,472	5,472	5,468	5,468	4,368	4,368
Engine and Fuel Tanks on Motor and Controls	7,350	7,350	5,118	5,118	6,150	6,150	4,219	4,219
Distributor System	30,000	13,800	30,000	13,800	30,000	11,100	30,000	11,100
Total	$53,182	$36,982	$49,150	$32,950	$50,178	$31,278	$47,147	$28,247
Annual Fixed Costs								
Depreciation	3,377	2,640	2,871	2,133	3,157	2,150	2,761	1,754
Interest @ 9%	2,393	1,664	2,211	1,483	2,258	1,407	2,122	1,271
Insurance	223	142	203	122	208	114	193	99
Total	$ 5,993	$ 4,446	$ 5,285	$ 3,738	$ 5,623	$ 3,671	$ 5,076	$ 3,124
Variable Costs to Apply 12" of Water								
Fuel*	1,921	2,216	1,413	1,630	1,942	2,241	1,429	1,649
Lube	214	246	25	29	218	251	29	34
Repairs	966	1,047	582	489	1,193	1,229	579	516
Labor @ $3.00	390	1,080	390	1,080	390	1,080	390	1,080
Total	$ 3,491	$ 4,589	$ 2,410	$ 3,228	$ 3,743	$ 4,801	$ 2,427	$ 3,279
Annual Costs Per Acre Irrigated								
Acres Irrigated	130	150	130	150	130	150	130	150
Fixed Costs	46.10	29.64	40.65	24.92	43.25	24.47	39.05	20.83
Variable Costs	26.85	30.59	18.54	21.52	28.79	32.01	18.67	21.86
Total	$ 72.95	$ 60.23	$ 59.19	$ 46.44	$ 72.04	$ 56.48	$ 57.72	$ 42.69

* Fuel prices used are $.38 per gallon of diesel and $.024 per KWH.

Table 3: A Comparison of Costs for Alternative Systems Irrigating a Quarter Section From a Well With 250 Feet of Lift

Water Situation	900 Gallons Per Minute and 250' Lift				600 Gallons Per Minute and 250' Lift			
Type Fuel	Diesel		Electricity		Diesel		Electricity	
Type System	Center Pivot	Tow Line	Center Pivot	Tow Line	Center Pivot	Tow Line	Center Pivot	Tow Line
Initial Investment								
Well Development	$13,360	$13,360	$13,360	$13,360	$13,360	$13,360	$13,360	$13,360
Pump, Base and Drive	10,981	10,981	9,181	9,181	8,453	8,453	6,653	6,653
Engine and Fuel Tanks on Motors and Controls	10,150	10,150	6,321	6,321	7,350	7,350	5,118	5,118
Distribution System	30,000	13,800	30,000	13,800	30,000	11,100	30,000	11,100
Total	$64,491	$48,291	$58,862	$42,662	$59,163	$40,263	$55,131	$36,231
Annual Fixed Costs								
Depreciation	4,049	3,313	3,358	2,261	3,647	2,641	3,141	2,135
Interest @ 9%	2,902	2,173	2,649	1,920	2,662	1,816	2,481	1,630
Insurance	256	175	228	147	229	135	209	114
Total	$ 7,207	$ 5,661	$ 6,234	$ 4,688	$ 6,539	$ 4,592	$ 5,831	$ 3,879
Variable Costs to Apply 12" of Water								
Fuel*	2,978	3,435	2,190	2,528	2,978	3,436	2,190	2,528
Lube	325	376	35	40	326	376	38	44
Repairs	1,340	1,371	647	564	1,391	1,457	653	599
Labor @ $3.00	390	1,080	390	1,080	390	1,080	390	1,080
Total	$ 5,033	$ 6,262	$ 3,262	$ 4,212	$ 5,085	$ 6,349	$ 3,271	$ 4,251
Annual Costs Per Acre Irrigated								
Acres Irrigated	130	150	130	150	130	150	130	150
Fixed Costs	55.44	37.74	47.95	31.25	50.30	30.61	44.85	25.86
Variable Costs	38.72	41.75	25.09	28.08	39.12	42.33	25.16	28.34
Total	$ 94.16	$ 79.49	$ 73.04	$ 59.33	$ 89.42	$ 72.94	$ 70.01	$ 54.20

* Fuel prices used are $.38 per gallon of diesel and $.024 per KWH.